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The Downside of Sexual Restraint: Sexual Frequency, Frustration, and Stress

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The Downside of Sexual Restraint: Sexual Frequency, Frustration, and Stress

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Abstract

The Downside of Sexual Restraint: Sexual Frequency, Frustration, and Stress

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Individuals in passionate love often experience a strong desire to engage in sexual intercourse with their partners. In a previous study (Crockett, Wright, & Loving, under review), individuals who were engaging in less (vs. more) sexual intercourse during the early stages of their romantic relationship were more likely to experience acute elevations in cortisol in response to a passionate love prime. In the present study, I examined whether sexual frustration mediates any association between sexual frequency and cortisol. Subjects underwent the same passionate love prime employed in Crockett et al.'s study, and completed measures of sexual intercourse frequency and feelings of sexual frustration. Salivary cortisol samples were collected before and after the prime. Sexual frequency was significantly correlated with sexual frustration, such that individuals who were engaging in less sex experienced more sexual frustration. However, sexual frequency and sexual frustration both failed to predict cortisol reactivity to the prime. I discuss the possible methodological issues that may account for these null effects and offer suggestions for future studies that examine the physiological consequences of sexual frequency and frustration.

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Chapter 1: Introduction

"When one is in love, one is absorbed, preoccupied, tense and intense, and filled with a sexual longing which permeates the rest of existence, making it both glorious and exhausting." -- Andrew Greeley (1991, p.122)

Individuals in passionate love (i.e., falling in love) experience a range of emotions and feelings, including a strong sexual desire for their romantic partners. Passionate love and sexual desire are so closely linked that they are often referred to as "kissing cousins" (Hatfield & Rapson, 2008). From an evolutionary perspective, the sexual desire experienced during passionate love is driven by a need to procreate and promote the survival of one's species (Fisher, 2000). Despite this strong desire, however, many individuals choose to not engage in sexual intercourse, whether because of religious or personal beliefs, feelings of inadequacy or insecurity, or fears (e.g., pregnancy or sexual transmitted disease; Sprecher & Regan, 1996). In such cases, individual behavior may be at odds with evolutionarily derived impulses.

The present study examined individuals' physiological reactions to not acting on the sexual drive associated with passionate love. Specifically, I proposed a follow-up study to a recent study by Crockett, Wright, & Loving (under review), which examined individuals' physiological responses to a passionate love prime where individuals reflected on the experience of falling in love with their partners. Individuals in newer relationships (versus more established relationships) who were engaging in less sexual intercourse were more likely to experience acute elevations in cortisol, one of the body's primary stress hormones. The present study tested whether sexual frustration mediated this association. Prior to discussing the theoretical rationale as to why infrequent sex-

derived frustration should result in increased cortisol, I first provide an overview of passionate love, focusing on its physiological consequences. Next, I discuss why passionate love and sexual desire often coexist as well as the evolutionary function of this association. I then review the relevant animal and human literatures that support the idea that frustration is likely to occur when individuals are unsuccessful at meeting basic drives or goals, and this frustration results in an increase in cortisol. Finally, in the last section I introduce the features of the present study designed to test these ideas.

PHYSIOLOGY OF PASSIONATE LOVE

Passionate love is a culturally universal phenomenon that has garnered significant research over the previous 40 years. We now know a great deal about passionate love, including that it causes intrusive thoughts and a desire for proximity and contact with one's partner, as well as a vast array of emotions from ecstasy to despair (Hatfield & Sprecher, 1986; Tennov, 1979). Passionate love also has profound physiological consequences. For example, the brain's activity during passionate love has been referred to as "mental chaos" (Birbaumer, Lutzenberger, Elbert, Flor, & Rockstroh, 1993); individuals who are "truly, madly, deeply in love" experience increased activity in regions of the brain associated with euphoria and reward, and decreased activity in the areas of the brain associated with sadness, fear, and anxiety when viewing a picture of their romantic partners (Bartels & Zeki, 2000). Similarly, other "pleasure centers" of the brain are also active when experiencing passion (Aron et al., 2005). In fact, the ventral tegmental area which is activated by passionate love is also activated by cocaine, thus supporting the metaphor "love is a drug".

Neurotransmitter and hormone levels are also altered when individuals are falling in love. Passionate love is associated with high levels of dopamine and norepinephrine and low levels of serotonin in the brain (Fisher, 2000). These neurotransmitters are significant as serotonin helps an individual maintain a calm demeanor, whereas dopamine and norepinephrine are associated with greater excitability. Changes in dopamine, norepinephrine, and serotonin help explain why passionate love results in increased energy, sleeplessness, loss of appetite, flushed face, accelerated breathing, and heart pounding (Fisher, 2000; Hatfield & Sprecher, 1986).

Individuals high in passionate love also experience an increased release of nerve growth factor (NGF) compared to those who are single or in long-term established relationships (Emanuele et al., 2006). The increase in NGF has a couple of implications. First, NGF is known to induce the release of the hormone vasopressin (Scaccianoce et al., 1993), which plays an important role in the formation of social bonds (Carter, 1998). Second, increasing levels of NGF activate the hypothalamic-pituitary-adrenocortical (HPA) axis. The HPA-axis is a feedback loop which determines how one's body responds to stress. Activation of the HPA-axis causes the hypothalamus to secrete corticotropin-releasing factor, which causes the pituitary gland to release ACTH into the bloodstream. ACTH then stimulates the adrenal cortex to secrete cortisol, one of the body's primary stress hormones (Loving, Heffner, & Kiecolt-Glaser, 2006). Indeed, individuals who have recently fallen in love (within the previous six months) have higher levels of cortisol than do individuals in more established relationships (Marazziti and Canale, 2004). Additionally, women who are more relationship-focused and high in

passionate love experience an acute increase in cortisol when reflecting on their romantic partners (Loving, Crockett, and Paxson, 2009).

SEXUAL DESIRE AND PASSIONATE LOVE

Another important aspect of passionate love is its link with sexual desire, a motivational state or drive to engage in sexual activities. Although two separate constructs, passionate love and sexual desire often coexist (Hatfield & Rapson, 2008). Importantly, sexual desire can lead to feelings of passionate love which promotes relationship development and attachment between members of a couple (Diamond, 2004; Regan, 2004). As such, there is a strong drive to engage in sexual intercourse during the early stages of one's romantic relationship (the initial phase of passionate love generally lasts between six and 18 months and then fades; Fisher, 2000). Many anthropologists contend that sexual desire and passionate love (and the bond between couple members) lasts long enough to aid in procreation and rearing of offspring, which subsequently promotes the survival of the species (Fisher, 2000). After this point, passionate love continues to decline, the relationship is more likely to deteriorate, and individuals can now move on to new partners to promote a larger genetic pool. Therefore, sexual desire is present in the early stages of one's romantic relationship (when passionate love is highest) to promote frequent sexual intercourse in order to produce healthy offspring as soon as possible.

Despite a clear link between passionate love and an underlying desire to engage in sexual intercourse, some individuals choose to abstain from sex or may not have sex as often as they would like. Indeed, there are a variety of reasons why an individual or a

couple may choose to abstain from sex. For example, paradoxically, some individuals choose not to engage in sexual intercourse because they believe it is too early in the relationship (Sprecher & Regan, 1996). Individuals abstain from sex for other reasons as well, including feelings of inadequacy or insecurity, personal and religious beliefs, and concerns or fears (e.g., pregnancy or sexually transmitted disease). Additionally, abstaining from sex may not be an individual's decision, but rather the choice of their romantic partner (Buss & Schmitt, 1993).

Regardless of the reason, abstaining from sex requires significant effort. Support for this contention can be found in the self-regulation literature. When individuals' self-regulatory resources are depleted, they are more likely to lose control over inhibitions and engage in sexual behaviors (Gailliot & Baumeister, 2007). Interestingly, the effects of diminished self-control are strongest among those with strong sexual desires and among couples with less sexual experience. In other words, individuals who engage in less sex with their romantic partners are likely to engage in more extensive sexual behaviors after self-regulatory depletion than their non-depleted counterparts (depletion does not affect sexually experienced couples' behavior; Gailliot & Baumeister, 2007). Therefore, not engaging in sexual intercourse is challenging, and likely stressful, especially when individuals are experiencing the strong feelings of sexual desire that often accompany passionate love (Fisher, 1998).

In an effort to examine individuals' stress levels within the passionate love context, a recent study by Crockett, Loving, & Wright (under review) examined whether sexual frequency impacted women's acute cortisol responses in response to a passionate

love prime. Specifically, subjects underwent a guided imagery session and reflected on falling in love with their romantic partners. Subjects were also asked how many times they had engaged in sexual intercourse with their romantic partners in the previous week and previous four weeks. Women who were in newer relationships and were having less sexual intercourse with their romantic partners experienced an acute increase in cortisol while reflecting on their relationships. Interestingly, women in more established relationships who were having infrequent sex did not experience a similar increase in cortisol. This finding suggests a habituation effect (e.g., Andrade, Orihuela, Solano & Galina, 2001; Wade & Ortiz, 1997); these individuals have habituated to abstaining from sex, making the lack of fulfillment of this drive less stressful.

Importantly, the underlying mechanism explaining why lower sexual frequency results in a stress response was not explored in Crockett et al.'s study. It is unlikely that the passionate love prime is evoking greater feelings of sexual arousal for individuals who are engaging in less sex as sexual arousal is associated with lower levels of cortisol (Hamilton, Rellini, & Meston, 2008). Additionally, basic conditioning principles would suggest that a relationship prime evokes arousal for those who have the most sex. Again, the Crockett et al. findings run counter to this idea, too, as those who were having frequent sexual intercourse did not experience any change in cortisol. Accordingly, I proposed that individuals who were having less frequent sexual intercourse become frustrated as a result of being unable to engage in more frequent sex with their partners. These feelings of frustration surface during the passionate love prime and then translate into increased levels of stress (i.e., cortisol) for individuals.

SEXUAL FRUSTRATION

Sexual frustration may explain why individuals who are having infrequent sex with their romantic partners experience an increase in cortisol following a passionate love prime. Frustration occurs when individuals are motivated to reach a particular goal and engage in goal-oriented behaviors, but fail to meet their goal expectations. Therefore, sexual frustration occurs when individuals are motivated to have sex with their romantic partners, engage in behaviors that may lead to sex, but do not have sex. Indeed, frustration is both aversive and stressful (Lewis, 1999) and cortisol levels increase when central goals are threatened or impeded (Blascovich & Tomaka, 1996).

There is a large body of literature on the connection between frustration and cortisol responses. Notably, sexual frustration is not necessarily different physiologically than general frustration. In fact, sexual frustration is negatively associated with individuals' sense of purpose in life, which suggests that sexual frustration may be indicative of a greater feeling of frustration or distress (Sallee & Casciani, 1976). In humans, however, relatively little is known about how HPA-activity changes in response to general frustration (Lyons, Fong, Schrieken, Levine, 2000) and no studies have examined sexual frustration specifically. Of the few studies that have examined physiological stress responses to frustration in human samples, most of the work focuses on feelings of frustration that are also associated with anger or aggression. These studies reveal that frustration experienced by children (age 7) and adolescents (ages 13-19) results in increased cortisol (Adam, 2006; Lopez-Duran, Hajal, Olson, Felt, & Vazquez, 2009).

Despite the limited human data, a number of studies in the animal literature find that frustration is associated with increases in cortisol. Importantly, animal research often allows for a high level of experimental control, use of integrative studies which include multi-method and multi-species analyses, and a greater potential to draw causal relationships from physiological mechanisms (Grippo, 2011; see also Pound, Ebrahim, Sandercock, Bracken, Roberts, 2004 for limitations). Therefore, not only do animal models have several benefits, but in conjunction with the studies which have found cortisol levels to increase in response to frustration for humans, these studies provide a strong foundation for the present study's goals and hypotheses.

A central theme within the animal frustration literature is examining how animals react when central goals are impeded. For example, evidence from both pig and monkey samples reveal that when these animals were faced with an obstacle that prevented them from securing food (e.g., a lid on top of a container of food) they became frustrated. The frustration of not being able to obtain food after engaging in several goal-directed behaviors caused higher cortisol levels for both pigs and monkeys, compared to the animals that actually solved the obstacle (Lewis, 1999; Lyons, Fong, Schrieken, Levine, 2000).

There is also animal research that directly examines the link between sexual frustration and cortisol. In one study, researchers used sexually trained boars to examine the physiological effects of sexual frustration. In this study, experimenters were able to manipulate whether a boar ejaculated when engaging in sexual intercourse with an artificial sow. When boars were unable to ejaculate (i.e., experienced sexual frustration),

they were more likely to engage in frustrative behaviors and had increased levels of cortisol (Bishop, Malven, Singleton, Weesner, 1999).

PRESENT STUDY

The present study was an extension of Crockett and colleagues' (under review) examination of the association between sexual intercourse frequency and cortisol reactivity to a passionate love prime. The overall methodology was similar. Subjects underwent a guided imagery task during which they reflected on falling in love with their partners (i.e., passionate love prime). Cortisol samples were obtained before and after the prime to assess subjects' reactivity to the guided imagery task. Subjects also completed several questionnaires including a measure of sexual frequency and sexual frustration. The present study, however, included some noteworthy changes. First, only women were examined in Crockett et al.'s study; it is unknown whether the effects of sexual frequency extend to men. There were a couple of reasons to suspect that there may be a gender difference with regards to cortisol responses to the passionate love prime and the influence of sexual frequency and frustration. On one hand, women are more likely than men to consider committed relationships as the primary context in which to experience sexual feelings and behaviors, whereas men are more likely to engage in sexual behaviors without necessarily being committed to their sexual partner (Peplau, 2003). Therefore, the passionate love prime may be more likely to evoke sexual feelings for women as they reflect on their relationships. On the other hand, men have greater feelings of sexual desire than women and are more likely to want more frequent sex in their relationships (Peplau). As such, men's cortisol reactivity may be greater than women's as a result of

the passionate love prime because they are more likely to desire greater sexual frequency (and thus, more likely experience sexual frustration if sexual intercourse frequency is low).

Additionally, the previous study examined subjects' acute cortisol reactivity to the passionate love prime using two salivary cortisol samples. The present study included an additional cortisol sample which allowed for examination of individuals' cortisol reactivity over a greater period of time. Peak cortisol responses occur 21 to 40 minutes from onset of an acute stressor (Dickerson & Kemeny, 2004). In the present study, reactivity samples are obtained approximately 24 and 36 minutes after the onset of the guided imagery task. Because the exact moment of a peak cortisol response is unknown, one sample may prove a better indicator than the other of individuals' cortisol reactivity.

Also, I recruited individuals who had been dating their partners for 12 months or less, whereas individuals in the previous study had been dating their partners for 24 months or less. As noted, Crockett et al. found a significant sexual frequency by relationship length interaction such that only those who were in newer relationships experienced an increase in cortisol when engaging in less sexual intercourse. Therefore, the present study focused on individuals who were in newer relationships in order to better understand the association between sexual frequency and cortisol reactivity.

In addition, sexual frequency was only assessed over the previous week. In the previous study, sexual frequency over the past week and four weeks both significantly predicted cortisol responses. I suspected that sexual frequency over the past week may

prove to be more relevant and predictive of individuals' feelings of sexual frustration and as such, sexual frequency over the previous four weeks was not assessed.

Finally, in the previous study we did not examine why sexual frequency influences cortisol reactivity. Without knowing the underlying mechanism behind why lower sexual frequency results in cortisol reactivity to a passionate love prime, it is difficult to extrapolate why these variables are associated with one another. In other words, it is possible that lower sexual frequency results in increased cortisol because of greater excitement during early stages of individuals' romantic relationships as they anticipate the eventual fulfillment of their sex drives. It is just as likely, however, that these cortisol responses are indicative of frustration due to these unfulfilled sex drives. Indeed, based on the evidence linking cortisol reactivity and frustration in the studies described previously, I would expect that feelings of sexual frustration arise as a result of the passionate love prime. This sexual frustration in turn causes individuals to experience more physiological stress (i.e., higher cortisol). As such, the present study examined whether sexual frustration mediates the effect of sexual intercourse frequency on cortisol reactivity.

The hypotheses for the present study were:

H1: Lower rates of sexual intercourse in the previous week are positively associated with increased cortisol.

H2: Feelings of sexual frustration mediate the association between lower sexual frequency and cortisol reactivity.

Chapter 2: Method

SUBJECTS

Twenty-five males and twenty-eight females (M_{age} = 20.25) were recruited from The University of Texas to participate in a "Relationship Experiences Study". Subjects were recruited via flyers posted around campus (e.g., dorms, kiosks, etc.). Subjects must have been involved in a nonmarital romantic relationship for less than one year and be in generally good health. The average relationship length was 6.8 months (*SD* = 3.11 months), and the majority of subjects were Caucasian (59%; 25% Asian; 5% African-American; 2% American Indian, and 9% "other"). Subjects received $10 compensation for participating in the study.

Because of the sexual nature of some of the questionnaires in the study, it was important for subjects' participation to be anonymous. Therefore, once subjects' laboratory sessions were scheduled, the research assistant explained to subjects that their names had now been deleted from our database and they had been assigned an ID number that was not tied to their personal identity. The ID number was included on all of the materials used during the laboratory session. Additionally, to promote the impression of anonymity, during the laboratory session participants placed their surveys into a box with other subjects' questionnaires rather than handing the surveys directly to the research assistant.

MEASURES

Frequency of Sexual Intercourse

Subjects were asked how many times they had sexual intercourse with their current romantic partner in the past week. Specifically, the open-ended item stated, "How many times in the past week have you had sexual intercourse with your partner?"

Sexual Frustration

A new scale was developed to measure sexual frustration. Specifically, subjects were provided with the following definition for sexual frustration:

"Sexual frustration is typically defined as a state of agitation or stress due to prolonged sexual inactivity and/or sexual dissatisfaction (e.g., a lack of desired sexual activity, or lack of variety in sexual activity). Please note: you do not necessarily have to engage in sexual intercourse with your partner to feel sexually frustrated."

Subjects then responded to four items, using corresponding five-point Likert scales, to assess their thoughts and feelings about their sexual relationship with their partners. See Appendix C for a copy of the sexual frustration scale.

Cortisol

Subjects provided three cortisol samples over the course of the study. The first sample provided an assessment of subjects' baseline cortisol levels. The second and third samples assessed subjects' reactivity to the guided imagery task (i.e., passionate love prime). Cortisol samples were obtained using Salivettes (Sarstedt, Germany). Salivettes include a piece of rolled, sterile dental cotton that is approximately 1.5 in. in length and slightly under 0.5 in. in diameter that subjects place in their mouths for two minutes.

Subjects were encouraged to simulate a chewing motion in order to help generate saliva. Once the sample was saturated, subjects placed the rolled cotton back into the plastic tube. After the experiment, all cortisol samples were frozen at -20°C until assayed.

PROCEDURE

Screening Survey

Subjects first completed an online screening survey. All subjects were screened for a number of conditions known to affect cortisol (i.e., use of tobacco products, specific medications, regular menstrual cycle, history of hormone problems, depression, anxiety, night shift work, and current pregnancy or nursing status). Subjects also had to agree to bring a picture of their romantic partner to the lab session. Finally, due to the diurnal cycle of cortisol, individuals must have been able to visit the lab in between the hours of 2 p.m. and 7 p.m. If individuals met the screening criteria, they were contacted by a research assistant to schedule their laboratory session. See Appendix A for the Screening Survey.

Laboratory Session

Upon arrival to the laboratory, a research assistant escorted subjects to a small room and asked for a picture of the subjects' romantic partner (if not previously emailed). Subjects were then provided with an overview of the study and a copy of the consent form (which was also viewed during the screening survey). Subjects were also reminded that their participation in the study was anonymous. After providing written consent, subjects were asked to complete a brief questionnaire. The first questionnaire included

various measures relevant to their health and romantic relationships. If subjects completed the survey in less than 20 minutes they were asked to sit quietly in the room and look at a picture book until the research assistant returned.

After completing the first questionnaire, subjects were asked to provide an initial saliva sample (i.e., baseline measure). Next, subjects engaged in a guided imagery task. The goal of the prime was to make subjects' feelings of passionate love for their partners as salient as possible (see Loving et al., 2009). Specifically, subjects recalled when they first met their romantic partners, realized they were falling in love, and first said, "I love you".

The guided imagery task began with the research assistant turning off the overhead light in the subjects' room, leaving the room dimly lit by a table lamp. The research assistant then led the subjects through a relaxation exercise. The purpose of the relaxation exercise was to have subjects clear their minds and begin to focus their thoughts only on their romantic partner and relationship. Next, the research assistant asked subjects to picture their romantic partner and to visualize all the details about him/her. The research assistant then placed the picture of the romantic partner on the table and used various verbal prompts to help subjects recall their experience of falling in love. The prompts included asking subjects to recall when they first met their romantic partners, when they realized they were falling in love and how they felt during this time, as well as when they first said "I love you" and the emotions they experienced as a result. Importantly, subjects were not asked to recall any details regarding sexual behaviors in their relationship (see Appendix B for copy of the passionate love prime).

After the guided imagery task, subjects were left in the room to speak into a digital recorder for three minutes and continue to recall their experience of falling in love. Subjects were reminded to look at the picture of their partners to help focus their thoughts. Next, subjects were given a piece of paper to write down any other thoughts they may have about their relationship and falling in love. Subjects were given 10 minutes for the writing task.

After the writing task, subjects completed another brief questionnaire that primarily served as a filler task. After completing the brief survey, subjects provided another saliva sample (i.e., reactivity sample #1). This second saliva sample was collected approximately 24 minutes after the guided imagery task began. Next, subjects completed the final survey, which included items assessing the subjects' frequency of sexual intercourse and feelings of sexual frustration (see Appendix C). Subjects were given 10 minutes to complete the final survey. After completing the survey, and approximately 36 minutes after the passionate love prime, subjects provided a final saliva sample (i.e., reactivity sample #2). Subjects were then thanked for their participation, compensated, and debriefed.

Chapter 3: Results

Descriptive Statistics

A summary of the descriptive statistics and correlations for all study and control variables can be found in Table 1. Sexual intercourse frequency ranged from zero to nine times a week, with 20 participants reporting that they had not engaged in sexual intercourse in the past week ($M = 2.21$, $SD = 2.51$). Subjects varied greatly in levels of sexual frustration, but on average reported feeling some sexual frustration ($M = 2.32$, $SD = .86$, *range* 1.25-5). Men and women did not significantly differ from one another in reports of sexual frequency ($t(50) = -0.89$, $p = .37$) or sexual frustration ($t(51) = 0.95$, $p = .34$).

As expected, Time 1 cortisol was significantly correlated with Time 2 cortisol ($r = .73$, $p < .01$) and Time 3 cortisol ($r = .78$, $p < .01$); Time 2 cortisol and Time 3 cortisol were also highly correlated ($r = .87$, $p < .01$).[1] Although the means for all cortisol samples are quite similar, there was variability in individuals' cortisol reactivity to the prime (28 subjects' cortisol decreased, 25 subjects' cortisol increased from Time 1 to Time 2). When examining the potential control variables, the number of alcoholic beverages consumed in the past week significantly predicted Time 1 and Time 2 cortisol ($r = -.32$, $p < .05$ and $r = -.30$, $p < .05$ respectively) and thus was retained as a control variable in the subsequent analyses predicting Time 2 cortisol.

Hypothesis Testing

The goal of the present study was to examine whether sexual frustration mediated the association between sexual frequency and cortisol reactivity. In order to support a

mediational model, three pathways had to be tested and supported: 1) sexual frequency predicts cortisol reactivity, 2) sexual frequency predicts sexual frustration, 3) sexual frustration predicts cortisol reactivity while controlling for sexual frequency. The first analysis examined whether lower sexual frequency predicted higher levels of cortisol during the prime (i.e., Time 2). Time 2 cortisol was regressed on sexual frequency while controlling for Time 1 cortisol and alcoholic drinks consumed in the past week. The main effect of sexual frequency on Time 2 cortisol was nonsignificant (b = -.001, $t(47)$ = -.08, p = .94), indicating that individuals' sexual frequency did not predict cortisol reactivity to the prime.

Given that sexual frequency did not predict cortisol reactivity, it was no longer possible to explore whether this association was mediated by sexual frustration. It is worth noting, however, that sexual frequency predicted sexual frustration, such that those who reported having less sex in the previous week also reported feeling more sexually frustrated (b = -.12, $t(50)$ = -2.66, $p < .01$). Yet, there was not a main effect of sexual frustration on cortisol (b = -.01, $t(48)$ = -.65, $p = .51$), nor did sexual frustration and sexual frequency interact to predict cortisol (b = .002, $t(45)$ = .20, p = .84).[2]

Chapter 4: Discussion

Overview

The present study employed a passionate love prime to examine whether sexual frustration mediated the association between sexual frequency and cortisol reactivity in men and women. This study builds off a previous finding in which individuals in newer relationships who were having less frequent (vs. more frequent) sex experienced an acute increase in cortisol during the prime (Crockett et al., under review). Three pathways needed to be confirmed in order to support a significant mediational model. I expected that sexual frequency would predict cortisol reactivity, such that those who reported engaging in less frequent sex would have higher cortisol levels during the passionate love prime than individuals who were engaging in more frequent sex. Unfortunately, the first step of this mediational model was not significant; the effect reported by Crockett et al. failed to replicate.

Albeit no longer possible to examine the mediational role of sexual frustration, the second step of the hypothesized model required sexual frequency to predict sexual frustration. This association was significant such that individuals who reported engaging in less sex during the previous week were more likely to report greater feelings of sexual frustration. Importantly, despite the link between sexual frequency and frustration, sexual frustration also failed to predict cortisol reactivity to the passionate love prime (i.e., the third step of the model). In sum, the hypotheses were not supported in the present study.

The present study is the third study from our lab to examine sexual frequency and cortisol responses to the passionate love prime and it is the first in which sexual frequency did not predict cortisol responses. As mentioned previously, the present study included several notable changes from the Crockett et al. (under review) study. These changes, which I originally expected to strengthen the study, might ultimately account for the failure to reject the null hypotheses. Below, I detail three differences between prior studies and the current one, and offer some arguments for how these methodological differences may have affected current results.

First, the measurement of sexual frequency may have limited variability in this key variable. Specifically, because I expected that recent sexual behaviors would be more predictive of sexual frustration, sexual frequency was measured as the number of times an individual had engaged in sexual intercourse with their partner in the previous week, as opposed to in the previous four weeks. Unfortunately, although there was some variability in responses (*current range* = 0-9 vs. *previous range* = 0-27), 36% of the sample reported that they did not have sex with their partners in the previous week. One possible reason for this high number of individuals reporting no sexual intercourse could be that many of our subjects were in long-distance relationships ($n = 21$); it is possible that some individuals had simply not seen their partner in the previous week. Indeed, individuals reported having less sex if they were in a long-distance relationship ($M = 1.33$) than individuals in geographically close relationships ($M = 2.93$; $t(48) = 2.29$, $p < .05$), with 61.9% of the individuals in long-distance relationships reporting not having sex with their partners (compared to 20.7% of those in geographically close

relationships). Therefore, although it appears that many individuals in our sample do not have sex with their partners, over the course of four weeks individuals in long distance relationships may begin to look more similar in sexual frequency to individuals in geographically close relationships. In addition to obtaining greater variability by measuring sexual frequency over four weeks, longer assessments of sexual frequency may also paint a more accurate picture of individuals' sex lives. Future research assessing sexual frequency should consider whether or not a large portion of subjects may be in long-distance relationships, as this factor can play an important role in the variability of sexual frequency if only measured over a short period of time.

Second, the current study may have suffered from unexpected lack of statistical power. Specifically, when examining males and females together, the sample size of 53 provides a power of .87 to detect a medium sized effect (i.e., an adequate amount of power). However, men and women's physiological responses to the passionate love prime might be functioning differently (and other unreported analyses support this possibility). Therefore, it may be best to examine these two groups separately. In fact, in order to truly replicate the previous finding it is only necessary to examine females' cortisol reactivity to the prime. This presents another problem, though, as the present study only includes 28 female subjects compared to 48 in the Crockett et al. study. Indeed, in order to achieve power of at least .80 and a medium effect size (f^2 =.15), I would need a sample size of 43 females. Therefore, if examining men and women separately, the null findings could be an issue of inadequate sample size and power to detect significant results (or a Type II error).

To summarize, the limited timeframe of sexual frequency and the smaller sub-sample of females could account for the inability to replicate the effect of sexual frequency on cortisol reactivity. That being said, it is more difficult to discern whether the nonsignificant effect for males is also the result of limited variability and/or inadequate sample size given that this is the first study to examine males' reactivity to the prime. In other words, it is certainly possible that men's cortisol does not vary as a function of their sexual frequency. With these possibilities in mind, it may be advisable to recruit a larger sample and examine recent sexual frequency over a longer period. These steps may increase the likelihood of finding significant effects (or confirm nonsignificant effects) for both males and females.

One additional limitation of the present study may account for the nonsignificant effect of sexual frustration on cortisol reactivity. Specifically, we added a third reactivity sample to the present study; it was obtained 36 minutes after the start of the passionate love prime. The timing of this third sample was based on a meta-analysis which concluded that peak cortisol responses occur 21 to 40 minutes from onset of an acute stressor (Dickerson & Kemeny, 2004). Interestingly, a recent study which examined cortisol responses to general frustration found that peak cortisol reactivity occurs 50 minutes after the onset of a frustrating event (Lopez-Duran et al., 2009). It is possible that the timing of the current saliva samples was not ideal to assess the potentially delayed cortisol response resulting from sexual frustration. Therefore, future studies examining the physiological consequences of sexual frustration should consider obtaining cortisol samples for at least 50 minutes after the "stressor" has occurred.

IMPLICATIONS AND FUTURE DIRECTIONS

Although my primary hypotheses were not supported, individuals who had less sex did report feeling more sexual frustration. This finding is congruent with the idea that individuals have a strong desire or motivation to engage in frequent sexual intercourse with their romantic partners and when this drive is unfulfilled, or this goal is not reached, they are more likely to experience sexual frustration. Importantly, sexual frequency is often positively associated with romantic relationship quality (Costa & Brody, 2007), such that individuals who engage in more sex often report more intimacy, satisfaction, and passion. Given the negative association between sexual frequency and sexual frustration, it is likely that greater sexual frustration may predict negative relationship outcomes. Unfortunately, empirical research on sexual frustration is severely lacking (whereas similar constructs like sexual satisfaction are studied often). Importantly, sexual frustration taps the stress or agitation that individuals feel in response to the sexual behaviors in their relationship; and it has been well-documented that stress can negatively impact one's health (see Lovallo, 2005 for review). Therefore, not only is it important for researchers to explore the effects that sexual frustration may have on romantic relationship quality, but it is also important to consider the effects frustration may have on individuals' health.

Despite many studies finding that frustration predicts cortisol levels, this association was not found in the present study. Another possible reason for this null effect is that it may be necessary to obtain cortisol samples when the actual frustrating event occurs, as was done in both the human and animal studies discussed previously

(e.g., Lopez-Duran et al., 2009; Bishop, Malven, Singleton, Weesner, 1999). In other words, although some individuals report high levels of sexual frustration, physiological evidence of this frustration may only occur after the actual event(s) that cause the frustration. For example, future studies could have participants provide saliva samples before and after sexual intercourse with their partners and operationalize sexual frustration as occurring when individuals fail to reach climax (similar to the Bishop et al., 1999 study). As mentioned previously, it may also imperative to obtain these salivary cortisol samples for at least an hour after these sexual behaviors have occurred. In these cases where cortisol levels are obtained within the context of actual sexual activity, sexual frustration may predict cortisol reactivity. In addition, one could examine whether or not repeated experiences of sexual frustration eventually leads to chronically higher levels of cortisol.

Similarly, future studies could examine cortisol levels before and after other sexual activities (e.g., heavy petting, oral sex) in which sexual intercourse does not occur. When considering the frustration model, it may be that engaging in these behaviors and never having sex may cause even greater frustration, as it could be argued that individuals are continually engaging in "goal-oriented" behaviors (e.g., foreplay) but failing to reach their ultimate goal (i.e., sexual intercourse). In fact, frequency of masturbation and other sexual behaviors (in the absence of sexual intercourse) has been associated with blood pressure reactivity, such that individuals who engage in these behaviors in lieu of sex have higher (worse) blood pressure in response to a speech task stressor (Brody, 2004). Therefore, it seems that the function of sexual intercourse may be

inherently different than other sexual activities with regards to stress responses. As such, it would also be interesting to examine whether a greater amount of these other behaviors (when sexual intercourse is infrequent or non-existent in the relationship) predicts greater cortisol responses to the passionate love prime

Overall, sexual frequency negatively predicts sexual frustration for individuals in new relationships. However, I did not find evidence that sexual frequency and sexual frustration predict cortisol reactivity. Importantly, several methodological issues may account for these nonsignificant findings. Therefore, the present null findings should not deter researchers from continuing to examine the physiological consequences of sexual behaviors and the cognitions associated with these behaviors. Indeed, sex is often an important part of a relationship; its influence should not be dismissed.

Chapter 5: Notes

[1] All subsequent results did not vary when predicting Time 2 vs. Time 3 cortisol. For parsimony, I will only be reporting results predicting Time 2 cortisol.

[2] I also examined the role of frequency of orgasms in the present analyses, but it functioned similarly to sexual frequency. Frequency of orgasms from sex in the past week failed to predict cortisol reactivity (b = .005, $t(40)$ = 0.61, p = .54); the number of orgasms an individual experienced from sex in the previous week was inversely associated with sexual frustration (b = -.12, $t(43)$ = -2.28, p <.05).

Table 1: Descriptive statistics and correlations between study variables

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Cortisol T1	–										
2. Cortisol T2	.73**	–									
3. Cortisol T3	.78**	.87**	–								
4. Sexual Freq.	-.15	-.09	-.17	–							
5. Sexual Frust.	-.03	-.11	.04	-.35**	–						
6. Reln Length	.08	.23	.19	-.17	.06	–					
7. Alcohol intake	-.32*	-.30*	-.24†	.31*	.04	-.02	–				
8. Caffeine use	.01	.05	.10	.14	-.02	.06	.30*	–			
9. Exercise hours	.01	.01	.07	.07	-.14	-.16	-.14	.01	–		
10. Birth contro1[a]	-.11	.01	-.06	.11	.24	.40*	.13	.27	.62**	–	
11. Period[b]	.01	.01	.07	-.11	-.01	.10	.16	.35†	.16	-.09	–
M	-.18	-.19	-.18	2.21	2.32	6.80	2.21	.75	3.77	.34	14.04
SD	.13	.15	.12	2.51	.86	3.11	3.2	1.08	1.54	.56	11.18
Range	(-.53, .04)	(-.63, .05)	(-.53, .09)	(0,9)	(1.25,5)	(.5,12)	(0,12)	(0,5)	(1,7)	n/a	(1, 45)

Note. [a]Birth control: 1 = yes, 2 = no; [b]Period = days since last period; † $p < .10$; ***p*** $< .05$; ****p*** $< .01$; $N = 53$

Appendix A: Screening Questionnaire

1. What is your first name and last initial? (e.g., Jane D.)

   _____

2. What is your sex?
   - ☐ Male
   - ☐ Female

3. What sex is your romantic partner?
   - ☐ Male
   - ☐ Female

4. How long have you been dating your current romantic partner?
   Years: _____
   Months: _____
   Days: _____

5. Are you in love with your romantic partner?
   - ☐ Yes
   - ☐ No

6. How old are you? _____

7. Are you currently taking any medications (not including birth control)?
   - ☐ Yes
   - ☐ No

8. If YES, please specify the medication:

   _____

   _____

9. Please select "Yes" or "No" to the questions below:

	Yes	**No**
Do you smoke, dip, or use other smokeless tobacco products?	☐	☐
Are you taking any diet pills?	☐	☐
To the best of your knowledge, do you or have you had any hormone problems?	☐	☐
Are you pregnant or nursing?	☐	☐

Would you say that your menstrual cycle is regular?
(If your menstrual cycle is naturally irregular, but currently
regulated by birth control please select "yes") □ □
Are you currently diagnosed with depression? □ □
Are you currently diagnosed as having anxiety? □ □
Do you work between the hours of 11 p.m. and 6 a.m.? □ □
If you are eligible, are you able to visit the UT campus some afternoon
for one hour between the hours of 2 p.m. and 6 p.m.? □ □

10. If you are eligible, we are asking all study participants to bring a picture to their study session. The picture should be of your current dating partner. Would you be able to bring in this picture (or email it ahead of time)?

□ Yes
□ No

We would like to contact you regarding your eligibility by e-mail and/or a phone call. At that point, we will also answer any additional questions you might have. (Note: We will only be able to let people know if they are ineligible via e-mail.)

11. What is your email address?

_____

(Note: Our e-mail address is LOVINGLAB@GMAIL.COM. You might want to add us to your address book to limit the likelihood that we end up in your SPAM folder)

12. What is your phone number? (Please use format xxx-xxx-xxxx)

_____

13. When is the best time to call?

_____

14. Did your romantic partner also sign-up for RES?

□ Yes
□ No

15. If YES, what is your partner's first name and last initial? (e.g., John S.)

_____

Appendix B: Passionate Love Prime

For today's session, we're going to use what is called a "guided imagery task" to help you think about your relationship with your partner. So that I can refer to your partner by name, can you please tell me his or her name? Great.

Try to get as comfortable as you can before we begin. You can put your head down or put your feet up; whatever will make you feel most relaxed. I'm going to turn off this bright overhead light– is that okay with you?

If YES --- turn off overhead light. If not, leave overhead light on and note on experimenter comment sheet that had overhead light on.

Okay. What I want you to do is try to relax and think about your relationship with your partner, _____. We hope that you'll be able to shut out all other thoughts and really focus on your thoughts, feelings, and relationship with _____ and nothing else. To help you do this, I'm going to take you through a brief relaxation exercise. It might seem a little awkward at first, but if you concentrate, you'll be able to stay focused on _____. As part of the exercise, I'm going to ask you to imagine a range of things about your relationship with _____. Sometimes I'll ask you to picture things by asking you questions. You DO NOT need to respond; just do your best to create a vivid image of your partner and the two of you by using the prompts. Does that make sense?

I want you to start by closing your eyes and clearing your mind. Try not to think about anything else but the sound of my voice and feeling your body relax. You should slowly notice any tensions in your body and just let each of them go. (PAUSE; count to 3) Good.

Now take a deep breath (PAUSE; count to 2) -- and exhale (PAUSE; count to 3). Feel the calming air flow through your nose, through your throat, and fill up your lungs. (PAUSE; count to 3).

Feel yourself relax from the top of your head, down your body, all the way to your toes. All your tension should be draining away. Inhale (PAUSE; count to 2) -- and exhale. (PAUSE; count to 3).

You should now be able to feel the relaxation of your entire body. Inhale (PAUSE; count to 2) and exhale again (PAUSE; count to 3) letting all the air out of your body. Your mind is cleared and your body is relaxed. (PAUSE; count to 3)

Now I want you to imagine _____ emerging from the clear space in your mind. (PAUSE; count to 3).

QUIETLY PUT PICTURE DOWN ON TABLE FACING THEM.

Picture _____'s face and try to visualize all the details about him/her. (PAUSE; count to 3) Think about the first time you saw or met _____. Picture where you were and what each of you were wearing. (PAUSE; Count to 3). What thoughts went through your mind when you first saw him/her? (PAUSE; Count to 3).

Think about the first time you realized you were falling in love with _____. What was it about him/her that captured your attention? How did she/he make you feel? (PAUSE; count to 3). Think about how good this time felt and the energy you had when you were falling in love with _____. Really try to capture and understand the feelings you were having during this time. (PAUSE; count to 3)

Now, I'd like you to recall the first time you said "I love you" to _____. Where were you? What exactly did you say to one another? What emotions were you feeling at that moment? (PAUSE; count to 3) Go ahead and take a moment to recreate this memory as vividly and fully as you can. Try to relive every aspect of falling in love with _____ right now. (LONG PAUSE; count to 6).

Really try to capture and understand the feelings you were having during this time. (PAUSE; count to 5). The key thing is that all you are thinking about is _____ and that all of the love you have for him/her is being felt by you right now. (PAUSE; count to 5).

Now, stay focused on all of these thoughts. Take another deep breath – (PAUSE; count to 2) --- exhale (PAUSE – count to 3). For the next three minutes, we'd like for you to talk about all the things going through your head. The key is to just keep talking about _____ and your relationship for the full three minutes. Start by talking about the first time you met. Then work through the history of your relationship and talk about when you first did something as a couple, when you first realized you were in love with _____, what it felt like and so on. Talk about your feelings of love for _____, and how that makes you feel. The key thing is that you try to express everything about how _____ makes you feel and that you keep talking for the entire time. Be as vivid as possible --- really try to recreate everything you feel about _____. Does that make sense?

Answer any questions.

Okay. You may begin as soon as I leave the room. I'll be back in three minutes. As you are talking, look at the picture of _____. It will help you focus on him/her and keep the image of _____ fresh in your mind.

Start digital recorder (say participant's ID number) then leave room.

Set timer for 3 minutes, then knock and reenter the room.

For the next 10 minutes, I want you to keep thinking about _____. Use the picture if it helps you keep your focus. Please use this sheet of paper to write down any additional thoughts you have about _____ and your relationship with him/her. I will be back in about 10 minutes.

Set timer for 10 minutes, then knock and reenter the room.

Appendix C: Sexual Experience Items

1. How many times in the **last 24 hours** have you:

a. Held hands with your partner	_____ time(s)
b. Hugged your partner	_____ time(s)
c. Cuddled with your partner	_____ time(s)
d. Kissed your partner on the lips (e.g., a peck)	_____ time(s)
e. Kissed your partner passionately ("French kiss")	_____ time(s)
f. Made out with your partner (e.g., kissed for a extended time)	_____ time(s)
g. Engaged in sexual petting above the waist through/outside clothing	_____ time(s)
h. Engaged in sexual petting below the waist through/outside clothing	_____ time(s)
i. Engaged in sexual petting above the waist inside clothing	_____ time(s)
j. Engaged in sexual petting below the waist inside clothing	_____ time(s)
k. Engaged in masturbation (with partner present)	_____ time(s)
l. Engaged in masturbation (without partner present)	_____ time(s)
m. Received oral sex	_____ time(s)
n. Given oral sex	_____ time(s)
o. Engaged in sexual intercourse	_____ time(s)

2. How many times in the **past week** have you:

a. Held hands with your partner	_____ time(s)
b. Hugged your partner	_____ time(s)
c. Cuddled with your partner	_____ time(s)
d. Kissed your partner on the lips (e.g., a peck)	_____ time(s)
e. Kissed your partner passionately ("French kiss")	_____ time(s)
f. Made out with your partner (e.g., kissed for a extended time)	_____ time(s)
g. Engaged in sexual petting above the waist through/outside clothing	_____ time(s)
h. Engaged in sexual petting below the waist through/outside clothing	_____ time(s)
i. Engaged in sexual petting above the waist inside clothing	_____ time(s)
j. Engaged in sexual petting below the waist inside clothing	_____ time(s)
k. Engaged in masturbation (with partner present)	_____ time(s)
l. Engaged in masturbation (without partner present)	_____ time(s)
m. Received oral sex	_____ time(s)
n. Given oral sex	_____ time(s)
o. Engaged in sexual intercourse	_____ time(s)

Sometimes individuals may feel a sense of *sexual frustration* in their romantic relationships. Sexual frustration is typically defined as a state of agitation or stress due to prolonged sexual inactivity and/or sexual dissatisfaction (e.g., a lack of desired sexual activity, or lack of variety in sexual activity). Please note: you do not necessarily have to engage in sexual intercourse with your partner to feel sexually frustrated.

With this definition in mind, please answer the following questions by circling a response:

1. How sexually frustrated do you *currently* feel?

1	2	3	4	5
Not Frustrated at All		Somewhat Frustrated		Very Frustrated

2. On average, how sexually frustrated have you felt over the past week?

1	2	3	4	5
Not Frustrated at All		Somewhat Frustrated		Very Frustrated

3. How much do you want more frequent sexual activity?

1	2	3	4	5
Not at All		A Little		A Great Deal

4. How satisfied are you with your sex life?

1	2	3	4	5
Not At All Satisfied		Somewhat Satisfied		Very Satisfied

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